OXYDEMETON-METHYL (METASYSTOX-R): METABOLIC FATE, DERMAL TRANSPORT AND HUMAN EXPOSURE DATA (APPENDIX B)

by

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ABSTRACT

Oxydemeton-methyl (METASYSTOX-R^{TM}, MSR) is a systemic insecticide-acaricide. The major-use crops include grapes, broccoli, cauliflower and sugarbeets. Oxydemeton-methyl is a restricted-use material in California, with stringent protective equipment requirements. Dermal absorption is 28.3 percent in 24 hours at exposure ranging from 0.5 to 50 ug/cm^2. Metabolic data in the rat suggests that biological monitoring may be feasible for parent compound in urine. Worker dermal exposure ranged from 1 mg/day up to 570.8 mg/person/day (mixer/loader/applicators). Estimated harvester exposure ranged from 1.7 to 31 mg/person/day.

The adverse effect requiring oxydemeton-methyl to undergo risk assessment was epididymal epithelial vacuolation in rats. This document was prepared as Appendix B for the Department's Risk Characterization Document for oxydemeton-methyl.

APPENDIX B

California Department of Food and Agriculture
Worker Health and Safety Branch

Human Exposure Assessment

OXYDEMETON-METHYL
(Metasystox-R)

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GENERAL CHEMISTRY

Oxydemeton-methyl is the common chemical name for S-2-ethylsulfinylethyl O,O-dimethyl phosphorothioate. The trade name is METASYSTOX-R (MSR). Oxydemeton-methyl is a systemic insecticide-acaricide. The chemical formula is $C_6H_{15}O_4PS_2$, with a molecular weight of 246.3 d. It is a clear-amber liquid at 25°C. It has a melting point of ~ -10°C and a boiling point of 106°C. Oxydemeton-methyl has a vapor pressure of $2.85 \cdot 10^{-5}$ torr. It is completely miscible in water and most organic solvents except petroleum ether. It is rapidly hydrolyzed in hot alkaline solutions (t1/2 <1 day at pH 9 and 40°C) and slowly hydrolyzed in cool acids (t1/2 = 94 days at pH 5 and 25°C). Neutral solution half-life is 40 days. It is not compatible with the following structural materials used in some application systems (16): PVC, neoprene, vinyl, polyurethane, nitrile.

FORMULATIONS

There are two formulations registered for agricultural/horticultural use in California. Both are MOBAY products. Metasystox-R is the major use material (EPA Reg. #3125-111 AA) while the other product, Metasystox-R 2 (EPA Reg. # 3125-111 ZA) is only registered for shrubs and shade/nursery trees. Metasystox-R is registered for the following crops: Cotton, corn, spear/peppermint, safflower, sorghum, sugarbeets, alfalfa, grapes, citrus, pears, plums, prunes, apples, apricots, cherries, beans, cole crops, cabbage, curcurbits, eggplant, lettuce, onion, peppers, squash, pumpkins, turnips, melons, nuts, flowers, shrubs, trees, and soil drench. Both formulations are twenty-five percent oxydemeton-methyl, with fourteen percent aromatic petroleum distillates accounting for the remaining active ingredient. There is an admonition concerning the material's flammability. Both formulations are Category II: WARNING. Protective equipment is specified for mixer/loaders on the MSR 2 label, including boots, gloves and aprons of rubber or similar impermeable material. A face-shield is also required.

Application rates nominally range from 1 to 2 pints (formulation) per acre for cabbage and onions, 4 pints for safflower, and up to 8 pints for nursery trees (against two specific pests).

REPORTED USAGE

The major use of oxydemeton-methyl as reported in the 1988 Pesticide Use Report from CDFA, is as follows:

TABLE ONE: Reported uses of oxydemeton-methyl during 1988

CROP	#APP	LB. APP	ACRES	PERCENT OF TOTAL LB. APPLIED
Broccoli	4,621	39,318	77,386	31
Cauliflower	3,822	27,550	55,825	22
Sugarbeets	298	11,281	21,659	9
Cabbage	1,815	9,709	14,966	8
Melons	327	7,897	23,983	6
Cotton	144	7,816	14,209	5
All Other Crops	2,012	23,512	-----	19
TOTAL	13,039	127,083	-----	100

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The CDFA "Report of Pesticides Sold in California in 1988 by Pounds of Active Ingredient" issued by the Pesticide Enforcement Branch reported 126,592 pounds sold.

CDFA implemented additional restrictions on the use of oxydemeton-methyl in December, 1986. Applications occuring after that date are now allowed only if made by licensed pest control operators. The following additional restrictions now apply:

1. Application of oxydemeton-methyl to landscape trees can now only be done by tree or soil injection. Greenhouse applications of oxydemeton-methyl are no longer allowed.

2. Specific warning information from the Department's Pesticide Safety Information Series must be made available to all who work with oxydemeton-methyl.

3. A closed system must be used for all mixing, loading and transferring operations.

4. Ground applicators, mixer/loaders, flaggers not in closed vehicles and cleaners/repairers must wear full body protective clothing and equipment which includes chemical resistant clothing for the torso, head, arms, hands, legs and feet as well as goggles/safety glasses or a full face shield.

5. Flagging for aerial applications must be done mechanically or electronically unless specific precautions to protect human flaggers are met. Precautions include: flagging from a closed vehicle with windows

rolled up and the flagger wearing clean long-sleeved coveralls daily, and providing a 100-foot buffer strip which will not be treated until the flagger has moved to safety away from the field.

6. Cleaning or replacement of protective equipment must be done daily.

DERMAL TOXICITY AND ABSORPTION

Pure oxydemeton-methyl is non-irritating to skin and only mildly irritating to the eyes (1). Formulated Metasystox-R, however, while not irritating to skin, causes extreme but reversible eye irritation (2). The guinea pig maximization test (3) showed oxydemeton-methyl to be a sensitizing agent. The file includes a letter from the registrant objecting to the use of this test to characterize the compound as allergenic, since the sensitization conditions of subdermal injection accompanied by Freund's adjuvant resemble nothing likely to occur in practice.

Two dermal absorption tests using radiolabeled compound apparently were done, but it is not clear whether or not CDFA received a final report for one of them. The protocol for that study is not available. A package of raw data, with analysis by Knaak (4), indicates that interpretation was problematic. Knaak's conclusions were :

1.) [oxydemeton-methyl] rapidly penetrated skin/or evaporates (sic).

2.) [oxydemeton-methyl] penetrated skin and was slowly transferred from skin to blood.

Knaak's letter also states "Radiolabeled MSR equivalents appeared in blood two hours after application of MSR, reached a maximum concentration in 4.0 hours, and then declined to a low, but still detectable level. The low levels appear to be plateau values."

A second dermal absorption study (5) was recently submitted using young adult female rhesus monkeys (wt. 4-11 kg), with five groups of four subjects each. Group A was treated by intravenous injection (IV); Groups B-E were used for topical administration. ^{14}C-Oxydemeton-methyl was dissolved in saline prior to IV injection to forearms, whereas it was dissolved in distilled water prior to topical administration to their lightly clipper-shaven abdomens. Amounts of oxydemeton-methyl per area (ug/cm^2) are shown in Table Two.

After administration, the monkeys were housed individually in metabolic cages. The application sites were washed with a liquid soap:water solution (1/1, v/v) followed by water rinsing 24 hours after exposure for groups A-D and 9 hours after exposure for group E.

Urine samples were collected 24 hours prior to exposure and daily thereafter for 14 days. Feces and pan washes were collected on the same post-exposure schedule. At the end of the study, one monkey each from Group A and from Group D was sacrificed and tissues were analyzed via liquid scintillation counter. Average dose recovery was 83.7 percent.

Percutaneous absorption for 24 hour human exposure was estimated by the researchers as follows:

$$\% \text{ dermal absorption} = \frac{\% \text{ topical dose excreted in urine (+ pan washes)}}{\% \text{ IV dose excreted in urine (+ pan washes)}} \times 100$$

TABLE TWO: Dermal and intravenous absorption of ^{14}C-oxydemeton-methyl in young adult female rhesus monkeys after 24 hour exposure.

Group Route	Dosage ug/cm^2	Percent Excretion Urine	Pan washes	Total	Percent Dermal Absorption
A/IV	---	77.4	2.2	79.6	-------
B/DRM	0.5	17.0	0.9	17.9	22.5
C/DRM	10.6	17.0	2.2	19.2	24.1
D/DRM	50.4	25.4	5.1	30.5	38.3
					MEAN = 28.3 $\pm$8.7
E/DRM	50.9	14.1	3.2	17.3	21.7

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Percent dermal absorption of groups B, C, and D following 24-hour exposure averaged 28.3 percent (Table Two). For the purpose of human exposure estimates, a dermal absorption of 28.3 percent for dosages in the range 0.5 to 50 ug/cm^2 will be used.

METABOLIC DISPOSITION

Metabolic or residue studies were done using rats, cows, hens and a goat. When oxydemeton-methyl was administered at rates greater than 3 mg/kg, residues were identifiable by chromatography. The primary species recovered were native oxydemeton-methyl and oxydemeton-methyl sulfone. The ethylsulfinylethyl chain, once separated by hydrolysis, appears as sulfonic acids, dimers and methylated forms. In the rat study (7), 40 percent of the dose was recovered unchanged in the urine within 24 hours, suggesting significant potential for bio-monitoring. None of the other studies included monitoring of excreta. Metabolites were identified in tissues in feeding studies of hens (8) and a goat (9). In both of these studies the highest concentration of labeled material was in the kidney, but the amount of unaltered oxydemeton-methyl was less than in the rat study. In goat kidney, 23 percent of the radiolabel was in the form of native oxydemeton-methyl; in hen kidneys, none of it was.

One provocative aspect of the goat study concerns the oxydemeton-methyl residues detected in the milk following administration of 7 mg/kg radio-labeled oxydemeton-methyl. The goat was milked morning and evening, and the dose of oxydemeton-methyl was administered following the morning milking. The evening milk was found to contain radioactivity corresponding to 3 - 4

ppm oxydemeton-methyl, while about 1 ppm was detected in the milk collected the following morning, suggesting rapid elimination. However, the residues in the morning milk were identified as being entirely unmetabolized oxydemeton-methyl; while only about 60 percent of the labeled material in the evening milk was native oxydemeton-methyl. The registrant hypothesized that this might be explained by a saturable excretion mechanism, or a back-reaction to regenerate oxydemeton-methyl from its metabolites; but no evidence was presented for either hypothesis.

Administration of doses of 0.5 mg/kg oxydemeton-methyl or less to chickens (11) and cows (13,14,15) rarely resulted in measurable residues. In one study (13), residues of 0.003 - 0.005 ppm were reported in milk from cows receiving 0.3 mg/kg oxydemeton-methyl (detection limit = 0.001 ppm); but another study (14) showed no detectable residues in milk from cows receiving 0.5 mg/kg oxydemeton-methyl, though the methodology was comparable. Comparison of residues in tissues from cows receiving 3.2 mg/kg oxydemeton-methyl with those from cows receiving 0.9 mg/kg showed proportional increases in some tissues, but greater than proportional increases in others.

Metabolism and excretion of oxydemeton-methyl do not appear to be well enough defined at present to allow CDFA interpretation of biological monitoring studies.

PLANT RESIDUE

The registrant has submitted several volumes of information concerning plant residue studies. The majority of the data deals with residue tolerance on or in commodities and is expressed in parts-per-million. Three studies conducted by the CDFA WH&S Branch have been referenced by the registrant to satisfy foliar residue data requirements. One study (17) follows grape foliar residue while the remaining two (18, 19) are concerned with cole crops.

The application rate for the grape study was 3.5 pints per 300 gallons per acre or 0.9 lb. active ingredient (a.i.) per acre. Table Three shows the residue values found during the 14 days of the study.

TABLE THREE: Average dislodgeable residue levels of oxydemeton-methyl on grape foliage after application of 0.9 lb. a.i./acre. Values are expressed in ug/cm^2.

TIME	MEAN VALUE (n=2)	MAXIMUM VALUE
Pre-Appl.	ND	ND
1 hour post.	0.921	0.954
24 hour	0.442	0.479
48 hour	0.525	0.549
72 hour	0.450	0.454
4 day	0.152	0.185
5 day	0.356	0.380
7 day	0.233	0.234
10 day	0.168	0.195
14 day	0.034	0.037

ND = none detected, MDL not listed.

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The two other studies on cauliflower and broccoli were done using an application rate of 0.5 lb a.i./acre. Table Four summarizes the residue concentrations found in those studies. There were seven cauliflower sites and two broccoli sites. Of the cauliflower sites, one was of an immature crop and had considerably higher residue values than the other sites. The average residue value of these plants has been kept separate from the other cauliflower data.

TABLE FOUR: Dislodgeable foliar residue levels of oxydemeton-methyl on cauliflower and broccoli after application of 0.5 lb. a.i./acre. Values are expressed as ug/cm^2. Time values have been normalized by WH&S to the nearest specified time interval.

TIME Post-Appl.	CAULIFLOWER [n=6] Mean	Range	BROCCOLI [n=2] Mean	IMMATURE CAUL. Mean
Pre-Appl.	ND	ND	ND	ND
1-4 hour	0.13	0.054 - 0.263	0.146	0.531
24 hour	0.063	0.019 - 0.186	0.104	0.242
48 hour	0.068	0.029 - 0.213	0.086	0.151
72 hour	0.051	0.020 - 0.115	0.064	0.136
7 day	0.018	0.006 - 0.320	0.014	0.104
14 day	0.004	ND - 0.006	0.005	NS

ND - None Detected (MDL = < 0.005)
NS - No Sample

CDFA, WH&S, H. Fong, 1988

This data suggests oxydemeton-methyl has a rapid initial dissipation half-life of 24 hours. It then appears to degrade at a considerably slower rate

after the first 24 hours.

Tolerance levels for oxydemeton-methyl (40 CFR para.180.330) range from a high of 12.5 ppm for mint hay to a low of 0.01 ppm for residues in meats and milk. Other agricultural commodities for human consumption (fruits and vegetables) range from 0.1 ppm to 2 ppm.

WORKER EXPOSURE

There are three documents available relating to worker exposure to oxydemeton-methyl. One is a surrogate data estimation of exposure (20). The second (21) is a mixer/loader/applicator (M/L/A) exposure study in an apple orchard using an airblast sprayer. The third (22) is a M/L/A study during cole crop pesticide treatment.

The surrogate study (20) made estimates for both ground and aerial applications. Several different materials were used to generate the surrogate information. The application rates of the surrogate data ranged from 0.6 to 1.5 lb. a.i./acre aerial and 0.5 to 3.0 lb. a.i./acre ground. Table Five lists the job categories and the registrant calculated exposures.

TABLE FIVE: Worker exposure to oxydemeton-methyl using surrogate data to calculate exposure levels. Mean application rate is 0.75 lb. a.i./acre for ground and 0.6-1.5 lb. a.i./acre for aerial. Values are expressed as mg/hour.

JOB TASK	DERMAL EXPOSURE (mg/hr)	
	Mean	Range
Airblast Applicator	7.6	1.6 - 13.6[x]
Flagger, Aerial	2.47	0.18 - 28.1[y]
Boom Applicator	1.53	0.04 - 4.7[x]
Mixer/Loader, Aerial	0.90	0.10 - 2.82[y]
Pilot	0.57	0.06 - 2.30[y]

x - total body exposure y - head, neck, and hands only

CDFA, WH&S, H. Fong, 1988

The registrant also conducted an actual field exposure study using oxydemeton-methyl in an apple orchard (21). To give an extreme case of exposure, an airblast sprayer was used, pulled by a tractor without an enclosed cab. Vapor phase (TENAX tubes), particulate (cascade impactor), dermal dosimetery (Durham & Wolfe) and hand wash (EtOH solution) monitoring was performed. Two separate studies were conducted. The conditions for each study are summarized below:

STUDY "A": 250 grams/hectare = 0.22 pounds/acre of oxydemeton-methyl
Application period ~ 4 hours **Combined = 4 hours**
Mix/loading period ~ 0.5 hours
Clothing: Long-sleeved shirt, pants, headgear, rubber gloves

STUDY "B": 375 grams/hectare = 0.33 pound/acre of oxydemeton-methyl (also Captan)
Application period ~ 3 hours **Combined = 3 hours**
Mix/load period ~ 0.5 hours
Clothing: Same as Study "A" except +NO GLOVES+

The results from these two studies are compiled in Table Six.

TABLE SIX: Results of worker exposure study for mixer/loader/applicators using oxydemeton-methyl. Work period for combined dermal exposure is 4 hours for "A" and 3 hours for "B".

	BODY EXPOSURE [mg/body part]	
	STUDY A[a]	STUDY B
Face[b]	1.5	5.4
Back	42.9	18.5
Neck, back of[b]	0.1	0.7
Chest	29.5	8.3
Throat[b]	0.1	0.5
Arms, lower[e]	42.5	5.0
Arms, upper[e]	80.3	12.1
Legs, lower	16.7	6.8
Legs, upper	71.8	15.9
TOTAL [mg]	285.4	73.2
SUBTOTAL FACE+NECK+THROAT [mg]	**1.7**	**6.6**
	GLOVED[d]	**UNGLOVED**
HANDS [mg]	Mix/Loading = ND Application = ND	Mix/Loading = 3.53 Application = 1.01
AIR: VAPOR [ug/m^3]	ND	67.1[c]
PARTICULATE [ug/m^3]	ND	ND

ND = none detected with an MDL of 0.5 ug/sample
[a]inadequate number of valid dosimeters, values from registrant estimation
[b]exposed area
[c]for applicator only
[d]value from wash of glove exterior
[e]cotton patch dosimeters underneath the cotton coveralls (upper and lower arm) had no detectable levels of oxydemeton-methyl.

CDFA, WH&S, H. Fong, 1988

These results yield the following eight-hour exposure estimates:

Study A: Total Exposure for 8 Hours = 570.8 mg/person
Unprotected Body Exposure = 3.4 mg/person

Study B: Total Exposure for 8 Hours = 195.2 mg/person
Unprotected Body + Hand Exposure = 29.7 mg/person

These results indicate a potential for exposure of workers engaged in M/L/A activity. However, no oxydemeton-methyl was detected on dosimeters located beneath the protective clothing. After review of the raw data, serious deficiencies were noted in this study. Half of the patch data in Study A was missing, either from loss of the patch (1 forearm, 1 thigh) or from what was termed by the registrant as "raw data not available" (back of neck+back, front of neck+chest, both upper arms). The registrant offers no additional explanation, even though the inadequate study reports a potential exposure value twice that of the study that does have an appropriate number of patches. Patch recovery is reported as two different values; 70 percent and 90 percent. Cholinesterase levels were not quantitatively reported, only stating "No influence on cholinesterase activity was detected." The procedure used to measure cholinesterase was not given, with no specification as to RBC or plasma (they measured "whole blood") nor was cholinesterase measured past 24 hours. Urinary biomonitoring data was not done, even though the workers' health was allegedly monitored and "No impairment of health was reported...", though there is no indication of the parameters measured. The unprotected body exposure is based on only one pad in Study A, as opposed to three pads in Study B. In reporting the Study B subjects' cholinesterase, the phrase "No significant inhibition...was determined". This is an unacceptable reporting of cholinesterase activity, since the registrant does not report the percent inhibition nor do they report their criteria for "significant inhibition".

Lacking further information from the registrant, exposure will be estimated on the total body exposure from Study A (570.8 mg/8 hour day) and the unprotected value reported in Study B (29.72 mg/8 hour day). These values are used although the serious flaws mentioned above do not instill a high degree of confidence in the data.

The second exposure study (22) was conducted by CDFA, Worker Health and Safety Branch. Eleven workers were monitored over the course of 24 applications. Application rates were between 0.5 to 0.75 lb. a.i./acre. Seventeen mix/load/applications were monitored in open-cab conditions, four M/L/A's were with enclosed-cabs, and three mix/loadings were monitored for aerial applications. Air monitoring used glass-fiber filters (for particulates) and XAD-4 resin tubes (for vapor phase). Body exposure was measured using both exterior (on the rainsuit) and interior (under the coveralls) dermal dosimeters. Hand exposure was measured using both knitted nylon gloves and hand washing with 0.5 percent surfactant in water. The workers wore waterproof gloves over the nylon ones. All mixer/loader work was done with a closed system. Table Seven shows the results of the studies.

TABLE SEVEN: Exposure ranges for mixer/loaders and ground applicators using oxydemeton-methyl. Application was done via ground boom or aerial boom. All M/L activity was done using a closed system. Values include protected (under rainsuit/cloth coveralls) and unprotected (on exterior of rainsuit) dosimeter residue levels.

ACTIVITY	TOTAL BODY EXPOSURE (ug/hour)				
	Minimum	Maximum	Mean	S.D.	Median
M/L/A (ground, open-cab) n = 17	33.5	412.1	158.4	105	130.2
M/L/A (ground, closed-cab) n = 4	52.2	151.5	114.4	44.4	126.9+
M/L (aerial) n = 3	160.9	253.3	211.4	46.8	220.1

+ arithmetic interpolation

CDFA, WH&S, H. Fong, 1988

Hand exposure contribution to exposure ranged from 8 to 62 percent of the total body exposure for ground M/L/A (open cab); from 29 to 70 percent for ground M/L/A (closed cab); and 32 to 73 percent for aerial M/L. The protected dosimeter's contamination ranged from 221 ug (28 ug/hr) to 792 ug (144 ug/hr). Seventeen of the twenty-four study periods had protected dosimeters which had no detectable residues but were assumed to have the MDL level on them (221 ug). Inhalation exposure monitoring indicated an inconsequential level of air contamination, with only 6 of the samples (out of 24) above the minimum detectable level (0.7 ug/m^3). The maximum air level detected was 4.75 ug/m^3. The hierachy of exposure to the various body parts was:

Unprotected dosimeters: Thighs>Forearms≥Shins>Chest≥Back=Shoulders

Protected dosimeters: Chest>All other areas

The Annual Average Daily Dosage (AADD) and Seasonal Average Daily Dosage were calculated using the previous exposure data. When available, median values were used for calculation.

TABLE EIGHT: Seasonal Average Daily Dosage (SADD: ug/kg/day) and Annual Average Daily Dose (AADD: ug/kg/day) for job tasks involved in the application of oxydemeton-methyl. Dermal absorption is estimated as 28.3 percent. Worker weight is 70 kg, except for flaggers, which is 54.8 kg. Work period is 40 days/year. Weekly work pattern for SADD calculation is six days on/ one day off per week.

APPL = Applicator MLA = Mix/Load/Applicator ML = Mix/Load Only

Job Task	Dermal Exposure (mg/8 hours)	Daily Dose (mg/24 hours)	Daily Dosage (ug/kg/day)	SADD	AADD
APPL, Airblast[a]	60.8	17.2	245.7	210.6	26.9
APPL, Boom[a]	12.2	3.5	50.0	42.9	5.5
MLA, Rain Suit[b]	39.5	11.2	160.0	137.1	17.5
MLA, Open Cab	1.0	0.3	4.3	3.7	0.5
MLA, Closed Cab	1.0	0.3	4.3	3.7	0.5
ML, Aerial	1.8	0.5	7.1	6.1	0.8
Pilot[a]	4.6	1.3	18.6	15.9	2.0
Flagger[a]	19.8	5.6	102.2	87.6	11.2

a - surrogate generated data
b - MOBAY MLA study: unprotected=exterior dosimeters
Rain Suit=unprotected areas + 5 % of unprotected value

CDFA, WH&S, H. Fong, 1989

Exposure of field-workers to oxydemeton-methyl during field activities and harvesting crops was estimated by the registrant from dislodgeable foliar residues (DFR) (28). Field activities performed in different crops in addition to harvesting include de-tasseling, scouting, tying, weeding, pruning and thinning. Dislodgeable residue data were submitted by the registrant for cauliflower, cotton, peppers, and sugar beets. These crops represent 4 crop groups in which each group has crops with similar height and reentry tasks (28). Surrogate DFR for navel oranges (29) was used to estimate citrus harvesters' exposure.

Crops in this study were treated with oxydemeton-methyl at the maximum label rates. The rates (lb a.i./acre) were 0.75 (sugar beets), 0.5 (cauliflower), 0.75 (cotton), and 0.5 (peppers). DFRs were determined for control and 0, 1, 2, 5, 7, 14, 21, 28, and 35 days post-application. The numbers of applications for cauliflower, cotton, peppers and sugar beets were 3, 2, 2 and 3 respectively.

A regression line was constructed from natural logarithm values of DFRs and the respective collection time. Initial deposition (intercept) and slope were derived from the regression line for each crop. These values were then used to estimate DFRs based on 2 sided leaf surface area at 2 days post-application. Two days post-application values were used because that is the established legal re-entry interval for all crops treated with oxydemeton-methyl. Potential dermal exposures (Table Nine) of workers in an 8 hour workday were estimated by CDFA from DFRs with an appropriate transfer factor. These factors were estimated by CDFA from CDFA field studies as well as from other published documents.

TABLE NINE: Potential dermal exposure of workers in crops treated with oxydemeton-methyl.

Crop	DFR (ug/cm^2)	Potential dermal transfer factor (cm^2/hour)	Potential dermal exposure (ug/person/8 hour-Day)
Cauliflower	0.03	7000[b]	1680
Cotton	0.06	15000[c]	7200
Pepper	0.55	7000[b]	30800
Sugar beets	1.88	3600[d]	54144
Citrus	0.26[a]	9400[e]	19552

[a]Adjusted according to the label rate of 6 oz ai./A.
[b]Ref. 30
[c]Ref. 31
[d]Ref. 28 (The transfer factor was calculated based on two-sided DFRs.
[e]Ref. 32

CDFA, WH&S, Tian, 1989

The workers are assumed to wear work clothing consisting of light long-sleeved shirt, long-legged pants, cotton gloves and shoes. A 10 percent clothing penetration of the potential dermal exposure is used to estimate dermal exposure of the workers. Absorbed daily dosage is estimated using 28.3 percent dermal absorption. Since this chemical produces cholinesterase inhibition and the effect on epididymis (part of the spermatic duct system), a seasonal average daily dosage (SADD) was also calculated (Table 10) based upon exposed-workdays over total workdays in the season. These workdays per season were estimated based on information received from Kern County Agricultural Commisioner Office, Grower Shipper Vegetable Association in California, farm advisers, custom pesticide applicators, and sugar beet processors. The exposed-workdays were estimated at one third of the workdays because of the short half-life of foliar residues (2-8 days), limitation of pre-harvest intervals (7-30 days) and number of applications for most crops per season (2-3 applications).

TABLE TEN: Seasonal average daily dosage of workers exposed to oxydemeton-methyl.

Crop	Potential dermal exposure (ug/person/8 hour-Day)	Dermal exposure (ug/pers/D)	Absorbed daily dosage[a] (ug/kg/D)	Seasonal average daily dosage[g] (ug/kg/season-D)
Cauliflower	1680	168	0.87	0.29[b]
Cotton	7200	720	3.72	1.18[c]
Peppers	30800	3080	15.91	5.30[d]
Sugar beets	54144	5414	28.00	9.33[e]
Citrus	19552	1955	10.10	3.37[f]

[a]Dermal exposure x absorption factor [28.3] ÷ weight [54.8 kg]
[b]70 exposed-workdays in 210 workdays in a season (or in one year)
[c]35 exposed-workdays in 110 workdays in a season
[d]25 exposed-workdays in 75 workdays in a season
[e]20 exposed-workdays in 60 workdays in a season
[f]20 exposed-workdays in 60 workdays in a season
[g]Absorbed daily dosage x exposed-workdays ÷ workdays/season

CDFA, WH&S, Tian, 1989

WORKER EXPOSURE ILLNESSES

The following table shows the number of illnesses and injuries associated with exposure to oxydemeton-methyl during the years 1982 to 1988, inclusive, as compiled by the Worker Health and Safety Branch (S.Edmiston, Pers. Comm., 1990). The illnesses/injuries have been classified into four types: systemic illness (largely anti-cholinesterase effects), eye injury (conjuntivitis, etc.), skin injury (dermatitis, erythema, etc.) and combination eye and skin injuries. There were no deaths associated with exposure to oxydemeton-methyl.

TABLE ELEVEN: Summary of cases associated with exposure to oxydemeton-methyl (ODM) and oxydemeton-methyl in combination with other acetylcholinesterase (AChE) inhibitors, 1982 to 1988.

	ODM ONLY			ODM AND OTHER AChE INHIBITORS*		
	Systemic	Eye	Skin	Systemic	Eye	Skin
1982	0	0	0	0	0	0
1983	0	0	0	23	0	0
1984	0	0	0	1	0	0
1985	0	0	0	5	0	0
1986	0	0	0	2	0	0
1987	2	0	0	0	0	0
1988	0	0	0	5	0	0
Total	2	0	0	36	0	0

*other AChE inhibitors include mevinphos, methomyl, methamidophos, dimethoate.

CDFA, WH&S, H. Fong, 1990

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